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P372 P389 P46X P476 P497 P500 P518 P550  
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**None**

(58) Field of search

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(54) **Microwave transparent barrier packaging materials**

(57) Plastics films or laminates especially suitable for use in packaging oxygen-sensitive liquid foodstuffs for microwave heating, comprise a plastic film with a metallic or non-metallic oxide coating on one surface. Laminates may comprise two or more such films joined with oxide faces adjacent. Films may have a thin plastic coating over the oxide, the coating itself also bearing a coating of the oxide. A coating of a metallic or non-metallic oxide on a plastics film may be formed by evaporating a metal or non-metal in vacuo, reacting it with oxygen or an oxygen containing gas or vapour and condensing the product on the film.

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

This print takes account of representations submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1982.

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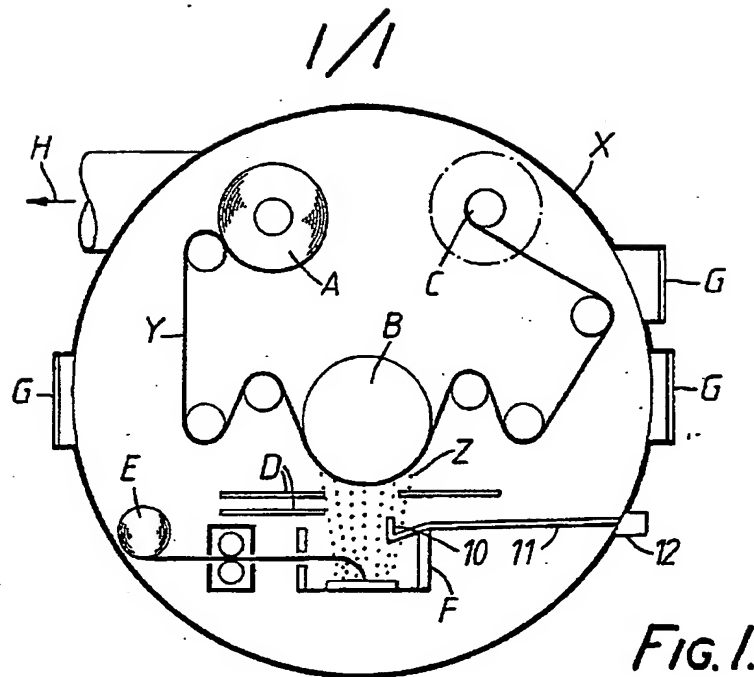


FIG. 1.

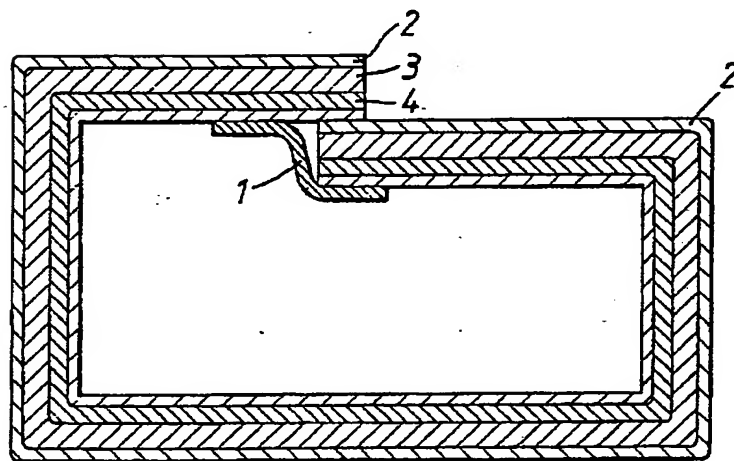


FIG. 2.

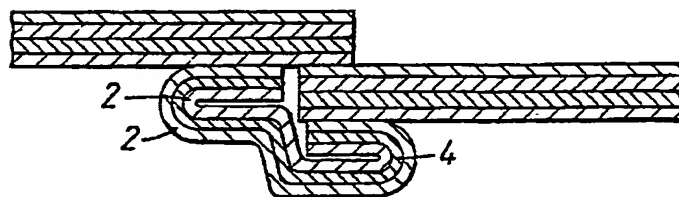


FIG. 3.

1. POLYETHYLENE SEALING STRIP  
 2. HEAT SEALABLE POLYETHYLENE  
 3. BOARD  
 4. BARRIER CORE

Microwave transparent barrier packaging materials

This invention relates to web materials with good barrier to oxygen and/or water vapour which are substantially transparent to microwave radiation and are especially, but not exclusively, useful for the construction of cartons for oxygen sensitive liquid foodstuffs which require to be heated in microwave ovens.

It is well known to package liquid or semi-solid foodstuffs sensitive to oxidative degradation in cartons fabricated from composites of thin cardboard, polyolefines and aluminium foil. Typical examples are the cartons sold under the trade names "Tetrapak" or "Combibloc". A typical construction of the composite used to produce such a carton is:

- a) Polyethylene layer for surface protection or heat seal.
- b) Board to provide rigidity.
- c) Polyethylene bonding layer.
- d) Aluminium foil to provide barrier.
- e) Polyethylene heat sealable layer.

Although widely used for packaging of liquids like fruit juice or milk and semi solids like soups, meat products and desserts, such cartons have the disadvantage that they cannot be heated in a microwave oven because the aluminium

foil web, which is essential for barrier to ingress of oxygen during storage, is not transparent to microwave radiation. Therefore, if it is required to microwave cook the product, it must be transferred to another microwave transparent container, which is inconvenient.

It is also well known to coat a plastic film, such as a film of poly (ethylene glycol) terephthalate, with a thin layer of metal such as aluminium, by vapour deposition in vacuo in order to achieve a good barrier of oxygen and water vapour, but such metallised films are also non-transparent to microwaves. US patent 3442686 describes coating of films of poly (ethylene glycol) terephthalate or polyolefines such as polyethylene or polypropylene with oxides of silicon or aluminium by vapour deposition in vacuo. Such oxides are transparent to microwaves, but the barrier of these materials, although enhanced significantly by the oxide coating, is still insufficient to allow their use in barrier cartons requiring long shelf life.

We have now found that, by taking a plastic film A and coating it with an oxide B using either existing techniques or the technique of reactive evaporation (C) described herein, and then either:

- 1) laminating the oxide coated film to another oxide coated film (with the oxide coated surfaces adjacent), or
- 2) coating the oxide coated surface with a thin layer of an organic coating E and then recoating with oxide,

It is possible to produce materials which both have excellent barrier properties (better than would be expected from known technology) and are substantially transparent to microwave radiation. These materials can be incorporated into laminates with board and polyethylene, and converted to cartons using known fabrication techniques.

Film A can be any suitable web substrate which is substantially transparent to microwaves and which can be coated with oxide, and can include polyester, polypropylene, polyethylene, polyamide, regenerated cellulose, polystyrene, polyacrylonitrile, polyvinyl chloride, polyvinylidene chloride, polysulphone or certain papers or boards including any composites or coextrusions of the above materials, or variants coated with other plastics. In one embodiment of the invention, poly (ethylene glycol) terephthalate or nylon 6 films are preferred, since when oxide coated and laminated or recoated as described in (1) or (2) above they give exceptionally low oxygen permeability ( $<0.2$  cc/metre<sup>2</sup>/

24 hours), comparable to the barrier of aluminium foil. This product can then be laminated or extrusion coated with polyethylene to form the composite for the carton. In another embodiment of the invention, polyethylene is preferred, since when oxide coated and laminated or recoated as described above it gives an adequate oxygen permeability (typically  $0.5 \text{ cc/metre}^2/24 \text{ hours}$ ) and is also of low cost and can be used to substitute both the aluminium and the polyethylene plies in the composite described above.

Oxide B can be any metal or non-metal oxide with good barrier to oxygen and adequate adhesion to the film A. The oxides of silicon ( $\text{SiO}_2$ ) and aluminium ( $\text{Al}_2\text{O}_3$ ) are preferred.

Existing techniques for the deposition of oxide coatings such as electron beam evaporation and condensation in vacuo or sputtering in vacuo onto the film web may be used. Both these techniques are well known and start with the oxide as feedstock. The thickness of each oxide coating should be in a range such that it provides good adhesion to the substrate, and has good mechanical strength and barrier. We prefer a coat weight of each oxide layer of  $0.03 - 0.5 \text{ grams/metre}^2$ , with a coat weight of  $0.15 - 0.3 \text{ grams/metre}^2$  being especially preferred.

We have now found that it is also possible to form an oxide coating on the film by a process involving reactive evaporation, ie the element or metal rather than the oxide is used as the feedstock and this is reacted during evaporation with oxygen or a gas or vapour of a compound of oxygen (such as water vapour) such that the transparent oxide is deposited on the film. This process forms one aspect of the present invention and is described in more detail below.

The reactive evaporation can be carried out in a suitably modified conventional film metallising chamber. Drawing 1 shows a diagrammatic representation of one embodiment of the apparatus, which comprises a vacuum chamber X for depositing a layer of metal such as aluminium on one surface of a continuous web of plastic film. Within the chamber is a supply reel A from which film Y passes over a cooled drum B to take up reel C. An aperture and shutter assembly D controls the zone of evaporation of a metal supplied from a wire feed E to a ceramic heater block F maintained at a temperature above the evaporation temperature of the metal at the chamber pressure. The chamber is provided with viewing ports G and is connected at H to vacuum pumps. When used for conventional metallisation, vapourised metal from the heater flows in a zone of evaporation, indicated by broken lines Z, towards

drum B and condenses on the film overlying the drum. In accordance with the present invention there is provided a discharge nozzle 10 connected by a pipe 11 to an inlet 12 for receiving a supply of a gas or vapour (not shown). The nozzle 10 is located within the zone Z and is directed in the direction of vapour flow from the heater to the drum. Several such assemblies may be mounted across the chamber to facilitate coating of wide films. It is a crucial feature of the invention that the gas is introduced into the zone of vapourising metal. If the gas is merely introduced into the chamber outside this zone, this produces a pressure rise within the chamber causing unsatisfactory deposition and eventually the mean free path of the vapourised metal is so reduced that no deposition occurs. Unlike other known processes for reactive evaporation such as reactive sputtering, it is not necessary to use any electrical or plasma discharge to initiate the reaction.

Lamination of two oxide coated films (process (1) above) with two oxide coated surfaces adjacent can be carried out by any conventional lamination technique. The nature of the adhesive used is not critical, and it does not need to have inherent barrier properties. Various curing and non-curing packaging grade adhesives, or hot melt resin adhesives or extrusion lamination with a polyolefine or



similar thermoplastic resin can be used. We prefer to use a moisture resistant, two component polyurethane curing adhesive.

The improvement in oxygen and moisture barrier achievable by laminating two oxide coated films in accordance with the present invention is considerably higher than might be anticipated from known technology. Thus it is normally anticipated that when two conventional plastic films, each with gas permeability X, are laminated together, the gas permeability of the laminate is approximately 0.5 X. In contrast, when two oxide coated films are laminated, in accordance with the present invention, improvements in barrier of typically 10 to 100 fold are achieved.

Application of an organic coating E to the oxide coated film (process (2) above) can be carried out by any conventional coating technique. Coating E can be any plastic resin coating with a thickness of less than 10 microns, which will adhere to and provide cover for a substantial percentage of the metallised surface of the substrate and give good adhesion to both oxide layers. Such coatings include water-based, solvent-based, or solventless thermoplastic lacquers or inks based on resins such as polyester, nitrocellulose, acrylic, vinyl or polyvinylidene chloride, hot melt coatings, extrusion

coated thermoplastic resins, and curing resin systems (cured by chemical cross-linking, ultra violet or electron beam irradiation or any other system). We prefer to use solvent-based polyester lacquers with a coating thickness of between 0.5 and 3 microns.

The improvement in oxygen and moisture barrier achievable by applying a thin plastic coating to the oxide coated film and recoating with oxide is again considerably higher than might be anticipated from known technology, with improvements in barrier of typically 10 to 100 fold. The presence of the thin plastic coating is crucial to the invention, and it is not necessary for said coating to have inherently good barrier properties. If the oxide coated film is merely recoated with oxide without the intermediate state of coating, the barrier improvement is limited to a factor of 2-3 at best.

Conversion of the materials of the invention into laminates with board suitable for carton manufacture can be carried out using conventional lamination techniques such as adhesive lamination or extrusion lamination using polyethylene. Typical constructions can include those below. For the function of the layers a-e refer to the description for a typical existing laminate given above.

1.   a    Polyethylene coating  
      b    Board  
      c    Polyethylene bonding layer  
          { Poly (ethylene glycol) terephthalate film  
          { Oxide coating  
      d { Adhesive  
          { Oxide coating  
          { Poly (ethylene glycol) terephthalate film  
      e    Polyethylene heat sealable layer
2.   a    Polyethylene coating  
      b    Board  
      c    Polyethylene bonding layer  
          { Oxide coating  
      d { Polyester coating  
          { Oxide coating  
          { Poly (ethylene glycol) terephthalate film  
      e    Polyethylene sealing layer
3.   a    Polyethylene coating  
      b    Board  
      c    Polyethylene bonding layer  
          { Oxide coating  
      d { Polyester coating  
      + { Oxide coating  
      e { Polyethylene film

- 4.   a     Polyethylene coating
- b     Board
- c     Polyethylene bonding layer
- { Polyethylene film
- d {    Oxide coating
- + {    Adhesive
- e {    Oxide coating
- { Polyethylene film
  
- 5.   a     Polyethylene coating
- b     Board
- c     Adhesive
- { Polyethylene film
- d {    Oxide coating
- + {    Adhesive
- e {    Oxide coating
- { Polyethylene film
  
- 6.   a     Polyethylene coating
- b     Board
- c     Adhesive
- { Poly (ethylene glycol) terephthalate film
- d {    Oxide coating
- + {    Adhesive
- e {    Oxide coating
- { Polyethylene film

Other constructions are also possible.

Fabrication of cartons from these laminates can be carried out using conventional techniques. The laminate can be formed into a tube by sealing either surface e to itself (fin seal) or surface e to surface a (lap seal). In the latter case it is preferable to use the known technique of sealing a further strip of polyethylene or a polyethylene/polyester/polyethylene composite along the longitudinal seal to avoid penetration of liquid from the carton into the board (see drawing 2). We have now found that a further improvement in the barrier of the carton is achieved if this strip is produced from a heat sealable barrier material, such as one of the materials of the invention, with a laminate of polyethylene film/oxide/adhesive/oxide/polyethylene film being preferred. This is preferably applied in the form of an open tube, as shown in drawing 3 which will seal to itself and to the carton so that no exposed edge can come in contact with the carton contents. This technique can also be used to improve barrier of conventional (non-microwaveable) cartons by sealing the exposed edge with a tube of barrier laminate such as polyethylene/foil/polyethylene or polyethylene/metallising/adhesive/metallising/polyethylene. Finally, the laminate tube can be transversely sealed and formed into a carton.

Whilst the materials of the invention are particularly useful for manufacture of microwave transparent cartons, they also have other uses. For example:

- a) They can be incorporated into flexible packaging laminates for the packaging of oxygen or moisture sensitive dry foods.

Typical constructions include:

1. { Poly (ethylene glycol) terephthalate film  
    { Oxide coating  
    { Polyester coating  
    { Oxide coating  
    Polyethylene film
2. Reverse printed film  
    { Oxide coating  
    { Polyester coating  
    { Oxide coating  
    { Polyethylene film
3. { Poly (ethylene glycol) terephthalate film  
    { Oxide coating  
    { Adhesive  
    { Oxide coating  
    { Polyethylene film

Many other constructions are possible according to the requirements of the end use.

- b) They can be included into flexible packaging laminates for bag-in-box packaging of liquids sensitive to oxygen and/or moisture.

Typical constructions include:

1. { Polyethylene film  
    { Oxide coating  
    { Adhesive  
    { Oxide coating  
    { Poly (ethylene glycol) terephthalate film  
    Adhesive  
    Ethylene vinyl acetate film
2. Polyethylene film  
    Adhesive  
    { Oxide coating  
    { Polyester coating  
    { Oxide coating  
    { Poly (ethylene glycol) terephthalate film  
    Adhesive  
    Ethylene vinyl acetate film.

Many other constructions are possible according to the requirements of the end use.

- c) They can be used for lids or closures for packs of fresh foods packed in a controlled gas atmosphere to increase their shelf life (controlled or modified atmosphere packaging). For this application, in addition to the benefits of high barrier and transparency, certain products of the invention offer additional benefits. Many foodstuffs packed using controlled atmosphere packaging such as vegetables or bakery products, give off water vapour which will form a mist on the inner surface of a lid made from conventional plastic film and partially obscure the foodstuff, giving the pack an unattractive appearance. We have found that by using an oxide coated film with the oxide surface facing the foodstuff, moisture evolved from the foodstuff forms a transparent film rather than a mist. This is particularly true of oxide coatings applied by the reactive evaporation technique.

Typical constructions suitable for controlled atmosphere packaging include:

1. { Poly (ethylene glycol) terephthalate film  
    { Oxide coating  
    { Polyester coating  
    { Oxide coating



2. { Orientated polypropylene film  
    { Oxide coating  
    { Polyester coating  
    { Oxide coating
3. { Polyethylene film  
    { Oxide coating  
    { Polyester coating  
    { Oxide coating

In order that the invention may be more fully understood, the following Examples are given by way of illustration only.

EXAMPLE 1

A 2 metre wide web of 12 micron poly (ethylene glycol) terephthalate film (Melinex S ex ICI Films) was placed inside a metallising chamber similar to that shown diagrammatically in diagram 1 and threaded from the offwind position A, over the drum B onto the wind up position C. 18 ceramic heaters F were arranged across the web and spaced 20 centimetres from drum B. A nozzle 10 was located between each heater and the drum, all the nozzles being connected to the inlet 12 to which was connected a controllable supply of oxygen gas. Each nozzle was positioned at the centre of the evaporation zone of its

associated heater and directed towards the drum. The chamber was evacuated to a pressure of  $10^{-3}$  torr and aluminium wire fed to each heater at a rate of 30 grams/minute, the web being passed over the drum at a speed of 300 metres/minute.

Initially, and in the absence of oxygen, approximately 25% of the aluminium evaporated was deposited on the web, giving a coating weight of 0.12 grams/metre<sup>6</sup>. Oxygen was then discharged through the nozzles and the flow rate increased until the coating on the film became just transparent, at which stage the flow rate was approximately 40 litres/minute. Chamber pressure was maintained at approximately  $10^{-3}$  torr.

The aluminium oxide coated film was found to have a coat weight of 0.21 grams/metre<sup>2</sup>, an oxygen permeability of 5 cc/metre<sup>2</sup>/24 hours at 23°C/0% RH and an MVTR of 1.9 grams/metre<sup>2</sup>/24 hours at 38°C/90% RH. Surface energy of the oxide coated surface, determined by standard wetting tension pens, was greater than 72 dynes/cm, ie the film was wetted by water. Wetting tension of the uncoated poly (ethylene glycol) terephthalate film was 38-42 dynes/cm.

#### EXAMPLE 2

The aluminium oxide coated poly (ethylene glycol) terephthalate film from example 1 was coated on its oxide surface with a layer of a commercially available two component polyurethane adhesive and dried to give a coat weight of 2.7 grams/metre<sup>2</sup>. The adhesive coated surface was then calendered to the oxide coated surface of a further ply of the same aluminium oxide coated poly (ethylene glycol) terephthalate film. After leaving for 1 week to allow the adhesive to cure, an oxygen permeability of 0.2 cc/metre<sup>2</sup>/24 hours at 23°C, 0% RH and an MVTR of 0.4 gram/metre<sup>2</sup>/24 hours at 38°C, 90% RH were measured on the laminate. The laminate could be formed into a container, filled with liquid, and heated effectively in a microwave oven without sparking.

A control sample in which the aluminium oxide coated film was laminated to uncoated poly (ethylene glycol) terephthalate film had an oxygen permeability of 3.8 cc/metre<sup>6</sup>/24 hours.

#### EXAMPLE 3

The aluminium oxide coated poly (ethylene glycol) terephthalate film from example 1 was coated on its oxide surface with a layer of a commercially available polyester-based lacquer and dried to give a coat weight of 1.5 grams/

metre<sup>2</sup>, and a coat thickness of 1.5 microns. After lacquering, oxygen permeability was 4.2 cc/metre<sup>2</sup>/24 hours at 23°C, 0% RH and MVTR 1.8 grams/metre<sup>2</sup>/24 hours at 38°C, 90% RH. The lacquered surface was recoated with a further 0.20 gram/metre<sup>2</sup> of aluminium oxide by the process described in example 1. The resultant film had an oxygen permeability of <0.2 cc/metre<sup>2</sup>/24 hours at 23°C, 0% RH and an MVTR of 0.4 gram/metre<sup>2</sup>/24 hours at 38°C, 90% RH, was transparent to microwaves, and had a wetting tension of greater than 72 dynes/cm.

A control in which the same aluminium oxide coated poly (ethylene glycol) terephthalate film was recoated with a further 0.21 gram/metre<sup>2</sup> of aluminium oxide without applying an intermediate lacquer coating had an oxygen permeability of 3.4 cc/metre<sup>2</sup>/24 hours at 23°C, 0% RH and an MVTR of 1.4 grams/metre<sup>2</sup>/24 hours at 38°C, 90% RH.

#### EXAMPLE 4

The experiment described in example 2 was repeated using a poly (ethylene glycol) terephthalate film coated with 0.22 gram/metre<sup>2</sup> of aluminium oxide by electron beam evaporation and condensation of that oxide in vacuo. This had an oxygen permeability after aluminium oxide coating of 5.4 cc/metre<sup>2</sup>/24 hours at 23°C, 0% RH and an MVTR of 1.9 gram/metre<sup>2</sup>/24 hours at 38°C, 90% RH. After lamination,

oxygen permeability was  $<0.2 \text{ cc/metre}^2/24 \text{ hours}$  at  $23^\circ\text{C}$ , 0% RH and MVTR  $0.4 \text{ gram/metre}^2/24 \text{ hours}$ .

#### EXAMPLE 5

The experiment described in example 3 was repeated using the electron beam evaporated aluminium oxide coated poly (ethylene glycol) terephthalate film described in example 4. Oxygen permeability of the produce was  $<0.2 \text{ cc/metre}^2/24 \text{ hours}$  at  $23^\circ\text{C}$ , 0% RH and MVTR  $0.4 \text{ gram/metre}^2/24 \text{ hours}$  at  $38^\circ\text{C}$ , 90% RH.

#### EXAMPLE 6

The experiment described in example 3 was repeated using a poly (ethylene glycol) terephthalate film coated with  $0.24 \text{ gram/metre}^2$  of silicon dioxide by electron beam evaporation and condensation of that oxide in vacuo. This had an oxygen permeability after silicon dioxide coating of  $3.5 \text{ cc/metre}^2/24 \text{ hours}$  at  $23^\circ\text{C}$ , 0% RH and an MVTR of  $1.4 \text{ grams/metre}^2/24 \text{ hours}$  at  $38^\circ\text{C}$ , 90% RH. After lacquering and recoating with oxide, oxygen permeability was  $<0.2 \text{ cc/metre}^2/24 \text{ hours}$  at  $23^\circ\text{C}$ , 0% RH and MVTR  $0.3 \text{ gram/metre}^2/24 \text{ hours}$  at  $38^\circ\text{C}$ , 90% RH.

EXAMPLE 7

The experiment described in example 2 was repeated using as substrate a 40 micron corona treated polyethylene film (Polyane CT ex Prosyn Polyane), which was coated on its treated side with 0.19 grams/metre<sup>2</sup> of aluminium oxide by the process described in example 1. Before lamination, this film had an oxygen permeability of 90 cc/metre<sup>2</sup>/24 hours at 23°C, 0% RH and an MVTR of 1.5 grams/metre<sup>2</sup>/24 hours at 38°C, 90% RH. After lamination, oxygen permeability was 0.5 cc/metre<sup>2</sup>/24 hours and MVTR 0.2 gram/metre<sup>2</sup>/24 hours.

EXAMPLE 8

The experiment described in example 3 was repeated using as substrate a 20 micron corona treated oriented polypropylene film (Shorko M ex Shorko Films), which was coated on its treated surface with 0.21 gram/metre<sup>2</sup> of aluminium oxide by the process described in example 1. Before lacquering and recoating with aluminium oxide, this film had an oxygen permeability of 70 cc/metre<sup>2</sup>/24 hours at 23°C, 0% RH and an MVTR of 1.7 gram/metre<sup>2</sup>/24 hours at 38°C, 90% RH. After coating as described with lacquer and aluminium oxide, oxygen permeability was 0.9 cc/metre<sup>2</sup>/24 hours at 23°C, 0% RH and MVTR 0.5 gram/metre<sup>2</sup>/24 hours at 38°C, 90% RH.

The invention includes:

1. A process for the production of a coating of a metallic or non-metallic oxide on a plastic film which comprises evaporation of a metal or non-metal in vacuo, reacting it with oxygen or an oxygen containing gas or vapour, and condensing the product on the film.
2. Any oxide coated film produced via the process described in paragraph 1.
3. Any oxide coated film produced via the process described in paragraph 1 which is substantially transparent to microwaves.
4. An oxide coated film as described in paragraph 3 with a barrier to oxygen of better than 10 times the barrier of the uncoated film.
5. An oxide coated film according to paragraphs 2-4 wherein the said film is poly (ethylene glycol) terephthalate.
6. An oxide coated film according to paragraphs 2-4 wherein the said film is a heat sealable polyolefine.

7. An oxide coated film according to paragraphs 2-5 wherein the oxide is aluminium oxide.
8. An oxide coated film according to paragraphs 2-6 wherein the oxide is silicon dioxide.
9. An oxide coated film according to paragraphs 2-8 wherein the oxide coat weight is 0.03 - 0.5 gram/metre<sup>2</sup>.
10. A plastic film laminate having low permeability to gases and moisture which comprises two layers of thermoplastic film coated with a metallic or non-metallic oxide and produced by either conventional processes or the process described in paragraph 1, joined together (with the oxide coated faces adjacent) by a layer of adhesive.
11. An oxide coated plastics film composite having low permeability to gases and moisture, which comprises a thermoplastic film coated with a metallic or non-metallic oxide on at least one face, overcoated on said oxide face with a substantially continuous thin plastic coating of thickness less than 10 microns and then recoated with oxide on the said face.



12. A laminate or composite according to paragraphs 10 or 11 wherein at least one of the said films is poly (ethylene glycol) terephthalate.
13. A laminate or composite according to paragraphs 10 or 11, wherein at least one of the said films is nylon 6.
14. A laminate or composite according to paragraphs 10 or 11 wherein at least one of the said films is a heat sealable polyolefine.
15. A laminate or composite according to paragraphs 10 - 14 wherein the oxide is aluminium oxide.
16. A laminate or composite according to paragraphs 10 - 14 wherein the oxide is silicon dioxide.
17. A laminate or composite according to paragraphs 10 - 16 wherein the oxide coat weight is 0.03 - 0.5 gram/metre<sup>2</sup>.
18. A laminate or composite according to paragraphs 10 - 16 which is substantially transparent to microwaves.

19. A composite according to paragraph 11 or as modified by paragraphs 12 - 18 wherein the said coating is polyester and the coat thickness is as defined in paragraph 11, thickness is as defined in claim 11, but preferably 0.5 - 3.0 micron.
20. The use as a packaging material or as a component of a packaging material of any of the materials described in paragraphs 2 - 19.
21. The use of any transparent oxide coated film with good gas barrier and high wetting tension in a package for controlled atmosphere packaging.
22. The use of any of the materials as defined above having an oxygen permeability of less than 1 cc/metre<sup>2</sup>/24 hours as a container or component of a container for microwaveable foodstuffs.
23. The use of a heat sealable barrier laminate, whether or not it is transparent to microwaves, in the form defined in drawing 3, as a sealing strip for cartons.
24. The use of a heat sealable microwave transparent barrier laminate or composite as defined in paragraphs

10 and 11 in the form defined in drawing 3, as a sealing strip for cartons.

25. The use of a laminate according to paragraph 14 in the form defined in drawing 3 as a sealing strip for cartons.

CLAIMS:

1. A plastics film laminate having low permeability to gases and moisture, which comprises two layers of thermoplastic film coated with a metallic or non-metallic oxide, joined together (with the oxide-coated faces adjacent) by a layer of adhesive.
2. An oxide-coated plastics film composite having low permeability to gases and moisture, which comprises a thermoplastic film coated with a metallic or non-metallic oxide on at least one face, overcoated on said oxide face with a substantially continuous thin plastic coating of thickness less than 10 microns and then recoated with oxide on the said face.
3. A laminate or composite according to claim 1 or 2, wherein at least one of the said films is poly (ethylene glycol) terephthalate, or nylon 6, or a heat sealable polyolefine.
4. A laminate or composite according to claim 1,2 or 3, wherein the oxide is aluminium oxide.
5. A laminate or composite according to claim 1,2,3 or 4, wherein the oxide is silicon dioxide.
6. A laminate or composite according to any of claims 1 to 5, wherein the oxide coat weight is 0.03 - 0.5 gram/metre<sup>2</sup>.
7. A laminate or composite according to any of claims 1 to 6, which is substantially transparent to microwaves.

8. A composite according to any of claims 2 to 7, wherein the said coating is polyester.
9. A composite according to claim 8, wherein the polyester coating thickness is 0.5 to 3.0 micron.
10. A process for the production of a coating of a metallic or non-metallic oxide on a plastic film which comprises evaporating a metal or non-metal in vacuo, reacting it with oxygen or an oxygen-containing gas or vapour, and condensing the product on the film.
11. An oxide-coated film produced by the process of claim 10.
12. An oxide-coated film according to claim 11, which film is substantially transparent to microwaves.
13. An oxide-coated film according to claim 12, with a barrier to oxygen of better than 10 times the barrier of the uncoated film.
14. An oxide-coated film according to any of claims 11 to 13, wherein the said film is poly (ethylene glycol) terephthalate.
15. An oxide-coated film according to any of claims 11 to 13, wherein the said film is a heat sealable polyolefine.
16. An oxide-coated film according to any of claims 11 to 15, wherein the oxide is aluminium oxide.
17. An oxide-coated film according to any of claims 11 to 15, wherein the oxide is silicon dioxide.

18. An oxide-coated film according to any of claims 11 to 17, wherein the oxide coat weight is 0.03 - 0.5 gram/metre<sup>2</sup>.
19. A plastics film laminate according to any of claims 1 to 7, wherein at least one of the oxide-coated films is as claimed in any of claims 10 to 18.
20. An oxide-coated plastics film composite according to any of claims 2 to 9, wherein said film and/or said plastic coated with oxide are as defined in any of claims 2 to 9.
21. The use as a packaging material or as a component of a packaging material of any of the materials as claimed in claims 1 to 9 or 11 to 20.
22. The use of a transparent oxide-coated film with good gas barrier and high wetting tension in a package for controlled atmosphere packaging.
23. The use of a material claimed in any of claims 1 to 9 or 11 to 20 and having an oxygen permeability of less than 1 cc/metre<sup>2</sup>/24 hours, as a container or component of a container for microwaveable foodstuffs.
24. The use of a heat-sealable barrier laminate, whether or not it is transparent to microwaves, as a sealing strip for cartons substantially as shown in Fig. 3 of the accompanying drawings.
25. The use of a heat-sealable microwave transparent barrier laminate or composite as claimed in any of claims 1 to 9, 19 or 20 as a sealing strip for cartons, substantially as shown in Fig. 3 of the accompanying drawings.

26. The use of a laminate comprising a heat-sealable polyolefine as claimed in claim 3, as a sealing strip for cartons, substantially as shown in Fig. 3 of the accompanying drawings.

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